

REMARKS/ARGUMENTS

Claims 1-11, 24 and 35 are active.

A Request for Continued Examination is filed with this paper to facilitate entry and consideration of the Rule 132 Declaration, in response to the final Action, also filed here.

Claim 1 is:

A fuel cell system comprising:
a fuel tank storing a fuel comprising dimethyl ether, water, 5-10 wt% of methanol, the mixing ratio of dimethyl ether and water is in a range of 1:3 to 1:4;
a vaporizer configured to vaporize the fuel;
a reformer configured to reform the vaporized fuel into a hydrogen rich gas;
a CO gas removal apparatus configured to remove CO gas in the hydrogen rich gas; and
a fuel cell unit configured to generate electricity by electrochemical reaction of the hydrogen rich gas and oxygen.

Applicants thank the Examiner for the courtesy of meeting the Applicants representatives on March 25, 2009 to discuss the rejections combining Okamoto, Muller and Pan; and the previously submitted data in the form of a Rule 132 Declaration.

During this meeting, the undersigned emphasized again that the prior art does not provide any suggestion for the claimed fuel components in the ratios defined in a fuel cell also including a reformer and indeed provide no indication as to how DME contributes to the reforming reaction in the fuel cell. That the art does not provide the requisite disclosure that would lead one to the claimed invention, the claims cannot be considered obvious. Further, there is nothing in what has been cited in the rejection that minimizes or contradicts the Applicants surprising findings for the claimed fuel, in the claimed mixing ratio, in the type of fuel cell being claimed.

Additional points of significance were discussed.

First, the claims here include a single fuel tank storing the fuel of DME, water, and methanol. The two primary references relied upon in the rejections have two tanks separating

water from methanol (see Okamoto FIG. 1 lower left portion, water tank **1** and methanol tank **2** and FIG. 1B of Pan, Fuel Tank **102** and water tank **110**). Thus, the references relied upon in the rejection teach away from that which is claimed.

Second, the claims require a certain amount of methanol 5-10% and mixing ratio of DME to water in a single tank, that is not at all suggested. A point made during the discussion, is first one has to ignore the teachings of the Okamoto and Pan patents to keep the methanol separated from the water and then figure out how to have a fuel that remains mixed and provides high levels of energy, e.g., unit density of energy generated. That is, the inventors have discovered a way to combine the components in a single fuel tank, while keeping the delicate balance of water solubility in the fuel and the energy output from that fuel.

This leads to the third point of the discussion that Applicants have provided data demonstrating the importance of 5 to 10 % of methanol to achieve the balance between dissolubility of water in the fuel while maintaining high energy density production, all being combined in a single fuel tank.

Thus, the invention set forth in the claims cannot be considered obvious from the teachings of the cited art.

These points and further analysis of the data presented previously is supported by an expert Declaration, attached here. (see paragraphs 6-9 of the Sato Declaration).

Mr. Sato, in the attached Declaration again explains the importance of the claimed concentration range of 5-10 wt% of MeOH.

He calculated the "S/C ratio" of the present invention and Pan's disclosure, based on the data represented in the declaration submitted on October 30, 2009.

<Information about S/C ratio>

Referring to the Japanese Patent Application Laid-Open H10-144335 (specifically, paragraphs [0003]-[0004]), attached to the Declaration with a machine generated English translation.

The supply ratio of the source gas and the steam to the reformer can be expressed by the numerical value of the steam-to-carbon ratio (hereinafter called as "S/C ratio"). The S/C ratio increases when the relatively larger amount of steam is supplied. The S/C ratio decreases when the relatively larger amount of the source gas is supplied.

It is preferable that the S/C ratio is kept to be as small as possible in the RHFC system because it makes it easy to take out the surplus heat and use the surplus heat for other purposes. However, if the S/C ratio is too low, carbon would be deposited onto the catalytic surface of the reformer and thus, the catalyst surface could be poisoned. Accordingly, the functions of the catalyst could not be properly demonstrated.

The theoretical minimum value could be 2.0. Also, the value of S/C ratio may be 3.0 to prevent the poisoning of the catalyst.

Calculating at 5wt% and 10wt % the S/C ratio of the claimed invention would be 1.32-1.89. (see attached Sato Declaration, pp. 3-4)

In Pan's disclosure S/C ratio of Pan's invention would be 17.0-33.8. (Sato Declaration at pp. 4-5)

What does this mean? The methanol range between the claimed fuel and Pan's fuel is seemingly similar because both of claimed fuel and Pan's fuel disclose 5-10% of methanol. However, as understood from the above calculation results, Pan's fuel is *completely different fuel* from claimed fuel because the amounts of the S/C ratio are significantly different from each other. (Sato Declaration at para. 15)

That is to say, as shown in the paragraph (0023) of Pan's disclosure, Pan merely discloses that the fuel including 1-10 wt% (3-5 wt%) of methanol could be applicable **for**

only the "direct methanol fuel cell (DMFC) type. There is no suggestion or teaching of Pan's fuel to be applicable to the Reformed type fuel cell (RHFC). (Sato Declaration at para. 16)

While Applicants understand that the Examiner contends that if the fuel cell is to be used in an application that requires high power out put, the optimal range of fuel concentration may become 5-10% by weight. However, applicant consider that Pan could not be incorporated to the fuel system of Okamoto because with regard to fuel efficiency, the principle of the DMFC as disclosed in Pan and the principle of RHFC as disclosed in claimed system are *completely different*. (Sato Declaration at para. 17)

If Pan's fuel is applied to the claimed system, S/C ratio of the fuel becomes dramatically higher than the claimed S/C ratio (more than one digit larger than claimed value) and thus, the fuel efficiency of the claimed fuel system would be significantly low. As a result, the system having a high efficiency for reforming fuel to hydrogen rich gas and a high efficiency for generating electricity with a small and simple structure (see page 2, line 17, of the present specification) could not be achieved. (Sato Declaration at para. 18)

Therefore, Pan's disclosure could not be incorporated into the fuel cell system of Okamoto as modified by Muller et al. (Sato Declaration at para. 19)

As explained in Mr. Sato's previous Declaration, the concentration between 5 and 10 wt% was something that required careful study so that the dissolution of the components could be maintained, i.e., methanol separates from DME/water, which is why Okamoto and Pan teach to keep them separate, only mixing through pumps when needed in the reactor. This was shown in the Declaration to be at about 5 % methanol. However, this is a fuel cell and therefore another important consideration in the type of fuel cell contained in the claims when being supplied from a single tank containing DME, water and methanol is the energy generated by that fuel in the cell. As described in Mr. Sato's previous Declaration, if

methanol is added in an amount greater than 10wt%, the energy density for each unit area of the fuel is decreased. (Sato Declaration at para. 20)

That this careful balance of a fuel contained supplied by a single tank was achieved at the specific concentrations and ratios as defined in the claims was achieved was not expected from what is taught by Okamoto, Pan and Muller. Indeed, Applicants do not see how that could have been expected when as discussed before and above, the types of fuels and the manner in which they are contained and supplied to the reactor are completely different from what is defined in the claims of this application. (Sato Declaration at para. 1')

As Okamoto, Muller et al. and Pan et al. fail to disclose or suggest the fuel cell defined in Claim 1 and the unexpected advantages obtained thereby, the claims would not have been obvious in view of these citations. Withdrawal of the rejection is requested.

The rejections of Claims 7 and 8 under 35 USC 103(a) in view of Okamoto, Muller, and Yonetsu; based on the combination of Okamoto, Muller, and Suzuki for Claim 9; or Okamoto, Muller and Kaneko for Claim 10 are also not applicable to the claims. These rejection differs from the Okamoto, Muller, and Pan rejection primarily for the reliance on (A) Yonetsu for the particular features of the fuel tank defined in claims 7 and 8; (B) the added features in Claim 9; and (C) reforming catalyst from Kaneko.

However, for the reasons similar to those detailed above, this combination of art does not provide any suggestion for the claimed fuel components in the ratios defined in a fuel cell also including a reformer and indeed provide no indication as to how DME contributes to the reforming reaction in the fuel cell. That the art does not provide the requisite disclosure that would lead one to the claimed invention, the claims cannot be considered obvious. Further, there is nothing in what has been cited in the rejection that minimizes or contradicts the

Applicants surprising findings for the claimed fuel, in the claimed mixing ratio, in the type of fuel cell being claimed.

Withdrawal of these rejections is requested.

A Notice of Allowance for all pending claims is requested.

Respectfully submitted,

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